

BRITISH COLUMBIA GUIDELINES FOR MINERAL EXPLORATION



Province of British Columbia
Ministry of Energy, Mines
and Petroleum Resources

**BRITISH
COLUMBIA
Mining
Inspection
Regions
and
Regional
Office
Locations**



**GUIDELINES FOR
MINERAL EXPLORATION**

MARCH 1989

Canadian Cataloguing in Publication Data

Main entry under title:

Guidelines for mineral exploration

Cover title: British Columbia guidelines for
mineral exploration.

ISBN 0-7718-8771-X

1. Prospecting - British Columbia. 2. Mining
law - British Columbia. 3. British Columbia. Mines
Act. I. British Columbia. Ministry of Energy, Mines
and Petroleum Resources. II. Title: British
Columbia guidelines for mineral exploration.

KEB349.G82 1989 346.71104'685 C89-092132-6

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	LEGISLATION AND APPROVALS	3
2.1	MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES APPROVALS	3
	Requirement to Give Notice	3
	Approval of Work on a Designated Site	4
	Approval of Underground Work	4
	Approval of Reclamation Program	4
	Procedure for Obtaining a Reclamation Permit	4
	Procedure for Maintaining a Reclamation Permit	5
	General Reclamation Permits	5
	Procedure for Obtaining a General Mineral Exploration Permit	6
	Procedure for Maintaining a General Mineral Exploration Permit	6
2.2	WORK REQUIREMENTS UNDER THE MINES ACT	6
2.3	SUMMARY OF OTHER LEGISLATIVE REQUIREMENTS	7
	Ministry of Crown Lands	7
	Ministry of Environment - Fish and Wildlife Branch	7
	Ministry of Environment - Waste Management Branch	7
	Ministry of Environment - Water Management Branch	8
	Ministry of Forests	9
	Ministry of Parks	9
	Department of Fisheries and Oceans	10
III.	WORK GUIDELINES	11
3.1	CLEARING AND SLASH HAZARD ABATEMENT	11
	Clearing	11
	Hazard Abatement	11
	Burning	11
	Burying	12
	Lopping and Scattering	12
	Chipping	12
3.2	ROAD CONSTRUCTION	12
	Design	12
	Construction	13
	Winter Construction	14
	Drainage	15
	Design	15
	Planning	15
	Drainage of Permanent Roads	15
	Drainage of Temporary Roads	17
	Stream Crossings	17
	General	19
	Bridges	20
	Culverts	20
	Fords	23
	Debris Bridges	23
3.3	DRILLING	23
3.4	TRENCHING	24
	Hand Trenching	24
	Backhoe Trenching	24

TABLE OF CONTENTS (Continued)

	Bulldozer Trenching	25
3.5	UNDERGROUND DEVELOPMENT	25
	Acid Mine Drainage	25
IV.	RECLAMATION GUIDELINES	27
4.1	CAMPSITES	27
4.2	TRENCHES, DRILL SITES AND MAJOR EXCAVATIONS	27
4.3	UNDERGROUND PORTALS AND WASTE DUMPS	27
4.4	ROADS	27
	Permanent Roads	28
	Abandoned Roads	28
4.5	REVEGETATION METHODS	28
	Methods of Seed and Fertilizer Application	28
	Recommended Seed Mixtures	29
	Recommended Fertilizer Applications	30
4.6	REVEGETATING WITH SHRUBS	30
	Selection	31
	Propagation	31
V.	APPENDICES	33
A	Mines Act, Sections 6-11.	35
B	Exploration Regulation - Uranium and Thorium	39
C	Notice of Work and Reclamation Program on a Mineral Property	43
D	Application for Approval of Underground Work	47
E	Design of Simple Pipe-Stem Harrow	51
F	Recommended Reclamation Treatments	53
G	Suggested Seed Mixtures for Use on Areas Disturbed by Exploration Activities in British Columbia	57
H	Addresses of Regulatory Agencies	59

INTRODUCTION^{I.}

These guidelines are written to inform individuals and companies of the requirements for conducting mineral exploration in the Province of British Columbia in compliance with the *Mines Act* (Appendix A) and with due regard for the Province's other resources.

This edition replaces the **Guidelines for Mineral Exploration** published in December, 1982.

These guidelines do not outline procedures under the *Mineral Tenure Act*. For information regarding the *Mineral Tenure Act* contact one of the offices of the Gold Commissioner (Appendix H).

MINERAL EXPLORATION IN RECREATION AREAS

Recreation Areas established under the *Park Act* and listed in the regulations of the *Mineral Tenure Act* are open for mineral exploration and development. Approvals under the *Mines Act* are obtained in the same manner as for all mineral properties, however they are subject to special review and permitting procedures as summarized in these guidelines.

The rights of an owner of a mineral tenure in a Recreation Area are different from those outside the Recreation Area, which may affect the type of work that can be carried out.

IMPORTANT NOTICE REGARDING EXPLORATION FOR URANIUM AND THORIUM

On February 28, 1987 the *Uranium Moratorium Regulation* was automatically repealed and, as a consequence, exploration for uranium and thorium is permitted.

A new regulation entitled *Exploration Regulation - Uranium and Thorium* (Appendix B) has been enacted.

Where a person intends to commence exploration for uranium, thorium or both anywhere in British Columbia, or intends to commence exploration in any of the Mining Divisions listed below, the Inspector of Mines and Resident Engineer should be contacted for advice (see Appendix H).

- | | | |
|-------------|------------|---------------|
| o Atlin | o Kamloops | o Similkameen |
| o Cariboo | o Nicola | o Slocan |
| o Clinton | o Omenica | o Trail Creek |
| o Greenwood | o Osoyoos | o Vernon |

Exploration for uranium and thorium is not permitted in Recreation Areas.

II. LEGISLATION AND APPROVALS

There are several acts and statutes which may govern mineral exploration. The first two sections of this chapter outline the approvals required by the Ministry of Energy, Mines and Petroleum Resources (MEMPR) under the *Mines Act* (Appendix A). The third section of this chapter outlines approvals which may be required from other agencies depending upon the location, land tenure, and nature of the exploration program. Although many of these approvals will be initiated by contact with the Inspector of Mines and Resident Engineer, the responsibility for obtaining these approvals rests with the proponent.

2.1 MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES APPROVALS

To initiate all approvals and permits of the Ministry of Energy, Mines and Petroleum Resources an operator must complete a *Notice of Work and Reclamation Program on a Mineral Property* (Appendix C) and submit it to the Inspector of Mines and Resident Engineer. Depending upon the nature of the exploration program, up to two months may be required before all permits and approvals will be issued; therefore, applications should be initiated well before work is planned.

REQUIREMENT TO GIVE NOTICE (Section 6, Mines Act and Section 2, Exploration Regulation - Uranium and Thorium)

The *Notice of Work and Reclamation Program on a Mineral Property* must be received by the Inspector of Mines and Resident Engineer at least 7 days before commencement of exploratory work. Provision of this notice does not, however, imply that the applicant can start work after 7 days. The applicant may only commence work after all approvals and permits have been obtained.

To explore for uranium or thorium or both, or to explore in a designated area under the *Exploration Regulation - Uranium and Thorium*, an operator must file the *Notice of Work and Reclamation Program on a Mineral Property* with the Inspector of Mines and Resident Engineer at least 30 days before commencing work, and must file a notice of the location of the intended exploration in the Gazette and in a local newspaper. The site referred to in the above notice will be considered a "designated site".

If, in the course of exploration at a site other than a designated site, uranium or thorium mineralization is encountered in a grade of 0.05% by weight or greater, a *Notice of Work and Reclamation Program on a Mineral Property* must be submitted within 72 hours of determining the grade.

At least 7 days before ceasing work, an operator must also give notice to the Inspector of Mines and Resident Engineer by completing and submitting a *Notice of Work and Reclamation Program on a Mineral Property*.

APPROVAL OF WORK ON A DESIGNATED SITE (Section 3, Exploration Regulation - Uranium and Thorium)

Under section 3 of the *Exploration Regulation - Uranium and Thorium* no person may commence exploration at a designated site without the written approval of the Chief Inspector of Mines.

To obtain this approval, the applicant must conduct a baseline survey of the designated site in accordance with Schedule C of the regulation and file a copy of the results of the survey with the Chief Inspector of Mines.

APPROVAL OF UNDERGROUND WORK (Section 6, Mines Act)

These procedures apply to underground exploration including the rehabilitation of workings for the purpose of surveying, mapping, sampling or drilling, and also to underground development work including drifting, cross-cutting, raising and drilling. These procedures do not apply to mines wishing to go into production. Requirements for mines wishing to go into production are outlined in a guidebook entitled *Mine Development Review Process- An Introduction*.

Under section 6(2) of the *Mines Act*, the owner, agent or manager of the mine must have the written approval of the Chief Inspector of Mines before working underground. To apply for this approval the following information must be submitted to the Inspector of Mines and Resident Engineer:

- o proposed work outlined on a *Notice of Work and Reclamation Program on a Mineral Property*
- o details of underground work outlined on a *Application for Approval of Underground Exploration Work* (see Appendix D)
- o a detailed map of present and proposed underground workings
- o a detailed plan of surface installations in relation to mine openings.

APPROVAL OF RECLAMATION PROGRAM (Sections 7-11, Mines Act)

Under section 10(4) of the *Mines Act* the owner, agent or manager of a mine must obtain a reclamation permit before commencing an exploration program involving surface disturbance by mechanical equipment. The procedure for obtaining this permit is outlined below and involves an application, a review by other resource agencies, establishment of special terms and conditions on the permit and placing of a reclamation security deposit. The amount of security is based on the area of land disturbed, to a maximum of \$2,500 per hectare initially. The advantages to a company maintaining a progressive reclamation program are obvious.

For exploration within a Recreation Area the amount of security may exceed \$2,500 per hectare pursuant to regulations under the Mineral Tenure Act, and will be based on the environmental sensitivity of the area and the potential impact of the proposed work.

Procedure for Obtaining a Reclamation Permit

APPLICANT: Sixty days before commencing work on a mineral property, the applicant

submits a completed *Notice of Work and Reclamation Program on a Mineral Property* to the Inspector of Mines and Resident Engineer.

MEMPR: The Inspector of Mines and Resident Engineer circulates the *Reclamation Program* to other resource agencies and advises the applicant of the requirement for reclamation security.

Programs of a sensitive nature such as underground development where there is potential for acid drainage, or exploration in a Recreation Area, may be referred to a regional Mine Development Advisory Committee for review.

APPLICANT: Arranges for reclamation security and forwards the security to the Inspector of Mines and Resident Engineer.

MEMPR: At the end of the 30-day referral period the Inspector of Mines and Resident Engineer finalizes permit conditions. Upon receipt of the reclamation security and upon approval of any underground work, uranium/thorium exploration or exploration in a Recreation Area, the Inspector of Mines and Resident Engineer will issue the reclamation permit to the operator.

OPERATOR: Upon completion of reclamation work, the operator can either request return of securities or maintain the permit in good standing (see below).

MEMPR: Upon request for return of securities, the Inspector of Mines and Resident Engineer arranges a property inspection, and if the reclamation program has been carried out and all terms and conditions of the permit met, the securities are returned to the operator.

Return of securities for work in a Recreation Area is subject to agreement by both the Ministry of Energy, Mines and Petroleum Resources and the Ministry of Parks.

Procedure for Maintaining a Reclamation Permit

Existing permits can be amended by annually submitting a *Notice of Work and Reclamation Program on a Mineral Property* at least 60 days prior to commencement of work. Any changes or additions to the work program will be reviewed in the same manner as the original program and may be subject to additional security. Upon approval of the amended program and receipt of any additional security that may be required, the existing permit will be amended to approve the proposed work.

GENERAL RECLAMATION PERMITS

General reclamation permits can be issued, upon written application to the Chief Inspector of Mines, to those companies which maintain a number of exploration projects. This general permit can be used to cover the initial phases of several projects provided they are under 3 hectares in area of disturbance and outside of any Recreation Area. The company is still required to submit to the Inspector of Mines and Resident Engineer for review and approval an annual *Notice of Work and Reclamation Program on a Mineral Property* for each project.

Properties of over 3 hectares disturbance or with ongoing exploration programs may require a separate permit and security.

Procedure for Obtaining a General Mineral Exploration Permit

APPLICANT: Sends a letter to the Chief Inspector of Mines requesting a general reclamation permit and including a summary of each property:

- o name of property
- o location
- o owner / operator
- o proposed surface disturbance on each property.

MEMPR: Will finalize permit conditions and notify the applicant of the requirement for security.

APPLICANT: Arranges reclamation security and forwards this security to MEMPR.

MEMPR: Upon receipt of securities the permit will be issued by the Chief Inspector Of Mines.

Procedure for Maintaining a General Mineral Exploration Permit

To maintain an existing permit, the operator must annually submit a report summarizing work done and work proposed for each property. Also, a *Notice of Work and Reclamation Program on a Mineral Property* must be filed with the Inspector of Mines and Resident Engineer at least 30 days before commencement of work on any property.

2.2 WORK REQUIREMENTS UNDER THE MINES ACT

All work in and about a mine must be carried out in accordance with the *Mines Act* including the following:

- o A manager must be appointed under section 25 of the *Mines Act*. This person may also act as a shiftboss if he has the necessary certification.
- o All work must be under the supervision of a certified shiftboss (section 24). The shiftboss must ensure that all work in and about the mine is in compliance with the *Mines Act*.
- o All miners must have medicals and *Certificates of Fitness* which must be filed in the mine office.
- o The ventilation system must meet the requirements of the *Mines Act* and be maintained by the manager to the satisfaction of the Inspector of Mines and Resident Engineer.
- o A permit must be obtained from the Chief Inspector of Mines for each diesel engine used underground. To apply, submit *Application for a Permit to Operate a Diesel Engine Underground* to the Inspector of Mines and Resident Engineer. Forced ventilation requirements and equipment are to be described and detailed on plans. Gas testing equipment and a record book are to be kept up to date by the shiftboss.

- o To store and use explosives at a mine, written permission from the Inspector of Mines and Resident Engineer is required. Such permission will be granted if the mine can and will comply with explosives and blasting regulations of the *Mines Act* and the federal *Explosives Regulations*.
- o All machines must be muffled to the approval of the Environmental Control Inspector, and operators must have personal hearing protection (muffs).
- o All buildings must meet the requirements of the *Building Code* and the *Electrical Code V*.
- o First aid must be maintained in compliance with the *First Aid Regulations* issued under the *Mines Act*.

2.3 SUMMARY OF OTHER LEGISLATIVE REQUIREMENTS

MINISTRY OF CROWN LANDS

Under the *Land Act*, the Ministry of Crown Land has jurisdiction over all Crown land other than that land administered by the Ministry of Forests and the Ministry of Parks.

To acquire right-of-way under the *Land Act* for access roads to a mineral property, contact a regional office of the Ministry of Crown Lands (see Appendix H). This does not apply to roads on the mineral property.

MINISTRY OF ENVIRONMENT - FISH AND WILDLIFE BRANCH

Responsibility for protection of wildlife habitat rests with the Fish and Wildlife Branch who review the *Notice of Work and Reclamation Program on a Mineral Property* on referral by the Inspector of Mines and Resident Engineer. Special conditions necessary to minimize impacts on fisheries and wildlife habitat are included in the reclamation permit.

MINISTRY OF ENVIRONMENT - WASTE MANAGEMENT BRANCH

Sewage Disposal

Pursuant to the *Waste Management Act*, a Waste Management Permit or Approval is required for the discharge of sewage effluent either directly to an open watercourse or, if discharged at a design capacity rate of 22.3 cubic metres per day (5000 gal/day) or more, to the ground. A design capacity discharge rate of less than 22.3 cubic metres per day is covered by the Ministry of Health under the *Public Health Act* and authorization must be obtained from that Ministry.

Refuse Disposal

Under the *Waste Management Act Regulations*, the discharge of solid domestic waste at an exploration camp does not require a Waste Management Permit or Approval if a properly designed incinerator is used. For camps under 10 person capacity, a Yukon type incinerator is acceptable. For camps having a 10 to 99 person capacity, incinerators having refractory linings, auxiliary air and combustion control systems are required.

Refuse in the camp must be collected and incinerated on a daily basis in such a manner as to minimize conflicts with wildlife. Otherwise, refuse must be removed from the camp site and deposited in an authorized landfill.

All inert, non-combustible refuse such as fuel drums, broken rigging and other construction or drilling refuse must be removed from the site on abandonment and, where appropriate, deposited in an authorized landfill.

Effluent Discharges

Effluent from drilling operations must be discharged to the ground with no direct overland drainage to an open watercourse. Water to be pumped out of old workings must be analyzed for pH, sulphate, alkalinity, dissolved metals and suspended solids, and the results must be submitted to the Regional Waste Management Branch (see Appendix H) to obtain approval for discharge to the environment.

Acid Generation Potential

When pyritic ores or host rocks are encountered, acid generation potential should be determined as early as possible during the exploration program. Acid generating material may require special handling to prevent acid mine drainage. The results of acid generation characterization tests should be submitted to the Waste Management Branch (see Appendix H).

Fuel Storage

Ministry of Environment bulk fuel storage guidelines have been drawn from the Provincial Fire Code. Secondary containment is required and must be sized to accommodate 110% capacity of a single tank installation. The containment must be constructed and maintained to ensure maximum practical impermeability, and must be placed in a location far removed and, if possible, sloped away from any open watercourse.

Spill Reporting

Pursuant to the *Waste Management Act* all spills of fuel or other hazardous materials must be reported immediately to the Waste Management Branch. To report a spill, phone 1-800-663-3456 toll free 24 hours per day.

MINISTRY OF ENVIRONMENT - WATER MANAGEMENT BRANCH

Under the *Water Act*, a water licence or approval may be required for the diversion and use of water from a stream, or for any alterations or changes in and about a stream. A stream is defined under the Act as any natural watercourse or source of water supply, whether usually containing water or not, and includes groundwater and any lake, river, spring, swamp, creek, ravine or gulch.

All major stream crossings require approval under the *Water Act*. Major stream crossings are defined as:

- o all bridges, and all culverts with a design capacity of 5 cubic metres per second or greater,
- o culverts with a fill height of 3 metres or greater,

- o all crossings on main streams within 300 metres of water intakes or private land.

For mineral exploration within a consumptive use watershed, special guidelines for protection of the watershed may be applied.

Inquiries regarding water licences and approvals should be directed to the Regional Water Management Branch (see Appendix H).

MINISTRY OF FORESTS

Occupation of vacant Crown land in Provincial Forests, cutting of timber and slash hazard abatement are controlled through agreements under the *Forest Act*. Depending on the location and nature of the exploration program proposed, any of the following agreements may be required:

- o **Special Use Permit (SUP)** - to occupy Crown land outside of the mineral tenure for access roads or campsites, etc.
- o **Road Permit** - to construct an access road through Crown land under a SUP, but does not apply to access on the mineral tenure.
- o **Free Use Permit** - to cut timber to be used directly in exploration activities.
- o **Licence to Cut** - to clear timber from areas to be used in the exploration program, or to clear timber under a SUP.
- o **Timber Sale Licence** - to clear timber where the Ministry of Forests determines that there is a market demand for the timber.
- o **Burning Permit** - to start any fire in a forest.

For inquiries regarding *Forest Act* agreements, contact the regional Ministry of Forests office (see Appendix H) or any Forest District office.

MINISTRY OF PARKS

Mineral exploration in Recreation Areas established under the *Park Act* is regulated jointly by the Ministry of Energy, Mines and Petroleum Resources and the Ministry of Parks under the regulations of the *Mineral Tenure Act*.

Specific work proposals may be subject to operational constraints and higher security deposits in order to protect recreationally or environmentally sensitive areas. The reclamation permit will be jointly approved by the Chief Inspector of Mines and the Regional Director of Parks. Access to the property and any work proposed off the property require a Resource Use Permit issued under the *Park Act* and must also be jointly approved by the Chief Inspector of Mines and the Regional Director of Parks.

Notwithstanding permits required by the Ministry of Environment, any use or diversion of water or any discharge of solid or liquid waste in a Recreation Area must be approved by the Regional Director of Parks.

DEPARTMENT OF FISHERIES AND OCEANS

The federal Department of Fisheries and Oceans has responsibility under the federal *Fisheries Act* for protection of fisheries sensitive areas.

In order to identify these sensitive areas and design work programs to protect the fisheries resource, contact a District Office or Habitat Management Office (see Appendix H) prior to commencing any work in or about a watercourse.

III. WORK GUIDELINES

All mineral exploration permits will be issued subject to these *Guidelines for Mineral Exploration*.

Based upon recommendations from other agencies, the Inspector of Mines and Resident Engineer may issue a permit with special conditions and place added restrictions on proposed exploration activities in order to minimize impacts on environmentally sensitive areas.

3.1 CLEARING AND SLASH HAZARD ABATEMENT

Clearing of forests and slash disposal are regulated by the Ministry of Forests. The appropriate *Forest Act* agreement (see Section 2.3) must be obtained from the local Ministry of Forests office prior to any clearing. Timber cut under a Licence to Cut or Timber Sale Licence must be scaled and stumpage paid.

CLEARING

Pre-logging of road rights-of-way is encouraged and, in some areas, may be required. In this procedure merchantable timber, usually in lengths greater than 2.5 metres with a top diameter greater than 10 centimetres, is decked and later sold by the Ministry of Forests. Pre-logging has been found to yield a more stable roadbed and, in many cases, has substantially offset slash abatement costs.

On main roads, all trees must be felled onto the right-of-way and those trees not salvaged must be totally disposed of by burning or burying.

On temporary trails and on drilling, trenching, portal or other similar sites, trees pushed over may usually be disposed of by lopping and scattering. In no case shall trees be left leaning into marginal timber. Total disposal is required within 400 metres of where any temporary road crosses a permanent watercourse or permanent road, and may also be prescribed in other areas where deemed necessary by the Ministry of Forests for effective forest management.

HAZARD ABATEMENT

Pursuant to section 117 of the *Forest Act*, an order to abate slash hazard will be issued in all cases where timber is cut and will generally call for slash treatments similar to the following:

Burning

All burning requires a permit issued by the local Ministry of Forests office. Within the Prince George and Prince Rupert Forest Regions a permit is only required between April 15 and October 15. Periods of high fire hazard may result in the cancellation of burning permits until more favorable conditions prevail.

Material under 20 centimetres in diameter should be round-piled not less than 5 metres away from the forest margin and burned when weather conditions permit. Larger material may be burned in a similar manner or, if this is not possible, bucked so that it is in close contact with the ground and windrowed at least 5 metres from the forest margin.

Unburned stumps may be scattered singly along the right-of-way, along with any charred material left after burning. In no case may debris be left bunched or in piles.

Burying

Burying is an acceptable method of slash disposal in most situations but requires a high level of supervision to ensure a satisfactory job.

Disposal areas must be cleared and a pit constructed to receive slash. Material to be buried must be cut into lengths of less than 4 metres and compacted within the pit so that nothing protrudes above ground level. Compacted piles should then be covered by at least 1 metre of mineral soil then seeded and fertilized.

Lopping and Scattering

On winter roads or temporary access roads of less than 10 metres width, and on drill sites, trenches and portals, slash may be disposed of by lopping and scattering. When this method is used, all trees felled must be limbed and the branches scattered. Boles of trees must be cut from the stump at the root crown and bucked so that they lie in close contact with the ground.

Chipping

Chippers have been used successfully for the disposal of slash less than 25 centimetres in diameter. When used in conjunction with pre-logging, the requirements for burning or burying are greatly reduced.

3.2 ROAD CONSTRUCTION

Poor road design and construction can account for a large proportion of disturbance in an exploration program. The following sections outline a number of guidelines for correct road design and construction.

DESIGN

Use existing roads whenever possible. Build the narrowest road possible consistent with safety and traffic needs. Plan for minimum permanent road length through the use of main access roads and secondary tote roads.

Avoid sensitive areas. Areas may be sensitive because of conflicts with other resources or because of problems in construction and reclamation. Some examples of sensitive areas are:

- o wildlife winter ranges (southwest-facing grassy or shrubby slopes), saltlicks
- o highly erodible areas, i.e. fine textured soils, steep slopes (Table 1)
- o areas directly visible from recreation areas
- o streams, lakes, marshes and bogs
- o alpine areas.

TABLE 1. GUIDE FOR ASSESSING SOIL EROSION HAZARD

TEXTURE	SLOPE				
	0—3° 0—5%	3—5° 5—9%	5—17° 9—30%	17—31° 30—60%	31° 60%
Fine	Moderate	High	High	High	High
Fine to medium	Moderate	Moderate	High	High	High
Medium	Low	Low	Moderate	High	High
Medium to coarse	Low	Low	Moderate	Moderate	High
Coarse	Low	Low	Low	Moderate	High

Locate roads to fit the topography, making use of natural benches, ridgetops and flatter slopes to avoid extensive cuts and fills. This will not only reduce construction costs but will avoid the possibility of unstable embankments.

Locate roads such that no portion of the road or road embankment lies within 50 metres of a lake or stream, except at stream crossings. The permission of an Inspector is required to locate a road within this limit.

Roads should be designed to keep grades as low as possible. Maximum grades of 8 to 10 percent are desirable, although short pitches of up to 15 percent can be accepted if necessary. Table 2 presents some approximations regarding slopes.

TABLE 2. SOME APPROXIMATIONS REGARDING SLOPES

REMARKS	GRADIENT		
	per cent	degrees	horizontal:vertical
Maximum for main haulage	8	5	11:1
Short pitches	10	6	10:1
Approximate two-wheel drive maximum	15	9	6:1
Maximum soil slope for vegetation	50	26	2:1
Angle of repose earth fill	67	34	1.5:1
Angle of repose loose angular rock	80	39	1.25:1

CONSTRUCTION

Proposed access routes must be inspected on foot and flagged at least 2 kilometres in advance of any construction equipment. Site specific relocations may then be made to avoid problem areas.

Clear only the minimum area needed, having due regard for slash disposal and ditching requirements. Before clearing borrow pits, test the area to ensure that adequate quantities exist. Obtain road gravel from approved locations only.

Where construction must take place in unstable soils or adjacent to major streams, try to take advantage of periods of dry weather.

In level terrain such as alpine tundra where cuts and fills are not required, tracked vehicles should be used for access without actual road construction. Road alignments must be clearly flagged to ensure that travel is confined to selected routes. This is also important for safety during winter white-outs.

Road embankments should be stabilized in accordance with the following guidelines:

- o Remove roots, vegetation and large rocks.
- o Pulverize large lumps of soil before compaction.
- o Control groundwater to prevent saturation of fill material, using pipe drains or filter blankets if necessary.
- o Avoid the high water zones of streams, and protect embankments from erosion using rip-rap where necessary.
- o Construct fill in lifts to achieve maximum compaction.
- o Reduce the slope angle of cut banks, round the tops of cut slopes and fall any trees that may become undercut by erosion.
- o Avoid any disturbance of the toes of cut slopes during road maintenance.
- o Leave a top dressing of slash on embankments, seed and/or mulch immediately to establish vegetation or, if necessary, construct protective works such as terraces, cribs or retaining walls.

Berms are to be left on roads that traverse steep slopes, however they must be breached at appropriate intervals so that runoff cannot become concentrated on the road surface.

Road width must be minimized when traversing steep slopes, and in some cases endhauling may be prescribed. Full bench construction, which will require specialized equipment such as loaders, backhoes and dumptrucks, is mandatory on slopes exceeding the angle of repose (see Table 2).

WINTER CONSTRUCTION

Road construction may be permitted during winter months under certain conditions. The main deterrents to winter construction are excessive snow depths, extreme groundfrost conditions and steep topography. Given favorable conditions winter construction may prove less damaging than summer construction, particularly in areas where high groundwater levels can result in serious erosion and stability problems during summer months. Properly constructed ditches and culvert crossings will control groundwater and surface runoff during spring breakup, resulting in a more stable roadbed.

In forested areas, sufficient right-of-way must be cleared to facilitate the removal of snow from the proposed road grade. Since this will require more clearing than normally recommended for temporary roads, winter construction should only be considered for permanent main roads.

Guidelines for winter construction of roads:

- o Avoid steep grades and side slopes.
- o Prevent snow and ice from entering the fill.
- o Construct elevated grade in known wet areas.

- o Surface the roadway with rock or shale in areas of fine-textured soils.
- o Install culverts and ditches as construction progresses.

DRAINAGE

Drainage design is the most important single element of road layout. Time spent before construction in identifying the drainage requirements of each section of road, and in ensuring that the appropriate equipment and materials are available for the job, will be fully compensated by savings in construction and maintenance costs.

Design

Drainage systems should be designed on a site specific basis and must be capable of carrying the maximum expected runoff.

Particular attention must be paid to areas of rapid runoff, such as:

- o areas of steep slopes
- o areas of shallow soils
- o areas of impervious fine-textured soils
- o non-forested areas
- o south and west facing slopes where snow melt is rapid.

Planning

Supply a sufficient number of culverts large enough to accommodate anticipated high water flows and sediment loads.

The position, size and type of all required culverts should be shown on the location plan given to the operators.

Drainage of Permanent Roads

On frequently used or permanent roads, or on any road in highly erodible soils, a system of ditches and culverts must be installed keeping in mind the following criteria:

- o Ditches and culverts must be large enough to accommodate the maximum anticipated flow. A drainage system that cannot carry the maximum runoff is worse than no system at all because the water is concentrated in one channel and can cause serious erosion. Culverts must be installed at frequent intervals to prevent concentrated discharges onto the lower slopes. Culverts should be located to avoid spilling onto unstable slopes wherever possible.
- o Catch basins should be installed above culvert inlets, with ditch blocks placed below the basins to direct water through the culvert (Figure 1). Drainage ways should be cleared of all construction debris and fill material. Rip-rap placed on the ditch block will minimize erosion and

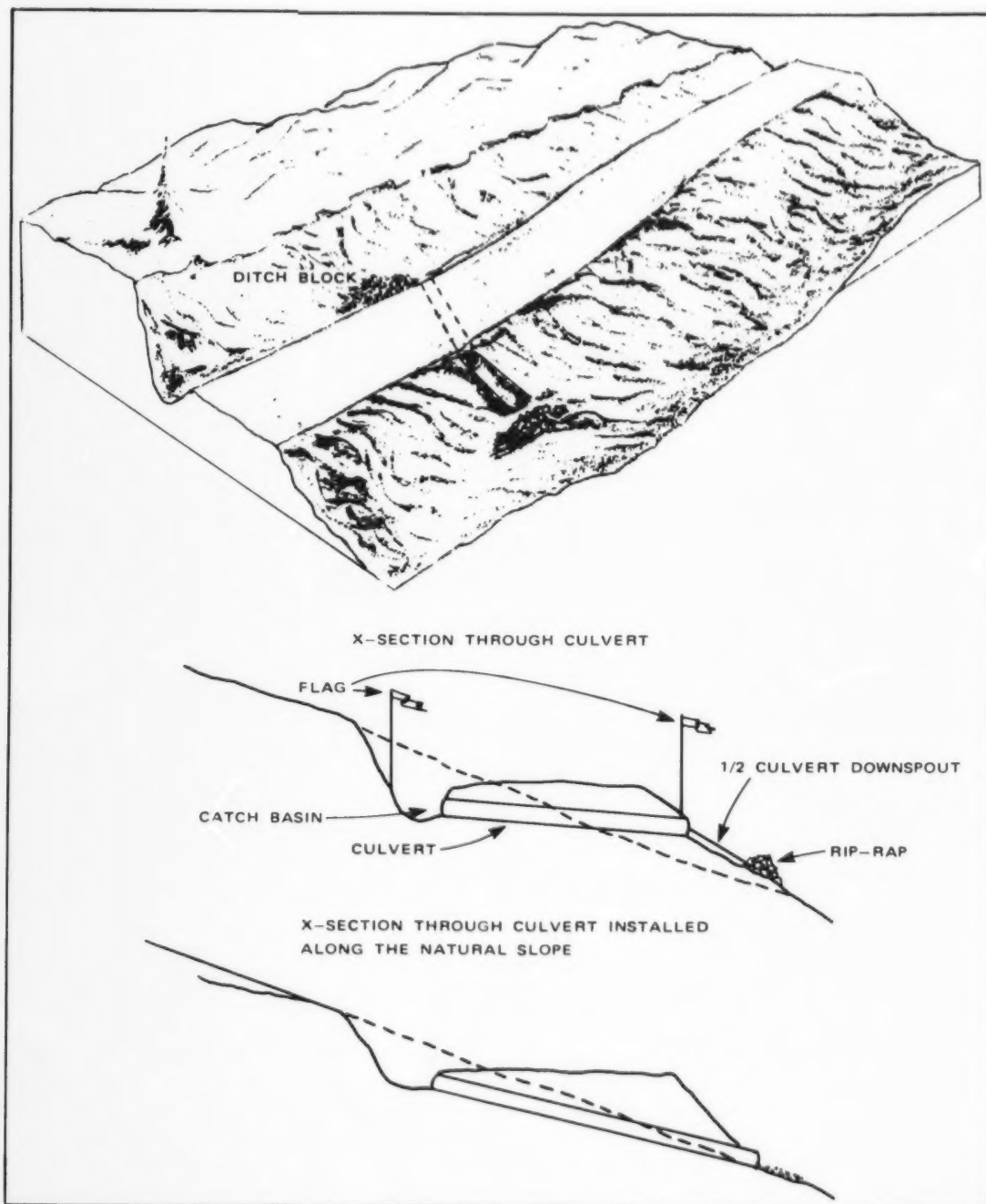


FIGURE 1
CULVERT INSTALLATION ON PERMANENT ROADS

washout. Culverts should be marked with large flagged stakes so that they can be easily located for regular maintenance.

- o Road surfaces should be crowned so that water flows into the ditches rather than collecting on the road. On long, steep hills the road grade should be rolled to discourage water flow along the road surface.
- o Culverts should be skewed to the same degree as water bars and should have a minimum 1 percent slope. Under conditions of high debris loads and in areas of unstable deep fills, culverts should be installed along the natural slope (Figure 1). This procedure requires a long culvert that must be installed before any fill is placed, but it improves the self-cleaning capability of the culvert and avoids discharge onto the fill slope.
- o Culvert discharges should be directed onto stable slopes. Rocks or other obstacles should be placed below the outlet to prevent erosion (Figure 1). Wherever possible, take advantage of low fills to release water. If drainage must be discharged over a deep fill then downspouts made from half-culverts should be placed on the fill slope. Route all drainage onto the forest floor so that sediment can settle out before the water reaches a stream. Slash from the road right-of-way may be windrowed along the toe of the fill slope to assist in the filtering process.
- o Special care must be taken to divert drainage away from borrow pits and waste dump areas.

Drainage of Temporary Roads

On seldom used or temporary roads, a system of dips and water bars may be used for drainage and erosion control (Figure 2). These must be close enough together that the amount of water collected can be easily diverted.

Appropriate spacing of water bars on various slopes in different soil types is presented in Figure 2. These intervals are approximate and should be modified to avoid diverting water onto deep fills or unstable natural slopes.

Water bars should be skewed to allow water to drain downhill across the road. As an extra protective measure water bars must be installed at the end of each field season along the entire road network.

In areas that have a low erosion hazard and where vehicle speed will be less than 30 kilometres per hour (20 mph) roads may be outsloped (Figure 3). Outsloping allows runoff to drain directly across the road surface and avoids the necessity of constructing and maintaining a system of ditches and culverts. If outsloping is not possible a drainage system of ditches and culverts must be used.

STREAM CROSSINGS

As in all other phases of the exploration program, stream crossings must be carefully considered in the planning stage so that problems can be identified and solved before they occur.



INTERVALS FOR WATER BARS

Slope Gradient	Erodible Soils (Silts and Clays)	Normal Soils (Loams)	Rocky Soils (Sand and Gravel)
	Metres	Metres	Metres
Under 5% (3°)	45	60	nil
5-10% (3-6°)	35	45	60
Over 10% (6°)	15	30	45

FIGURE 2
CONSTRUCTION AND LAYOUT OF WATER BARS

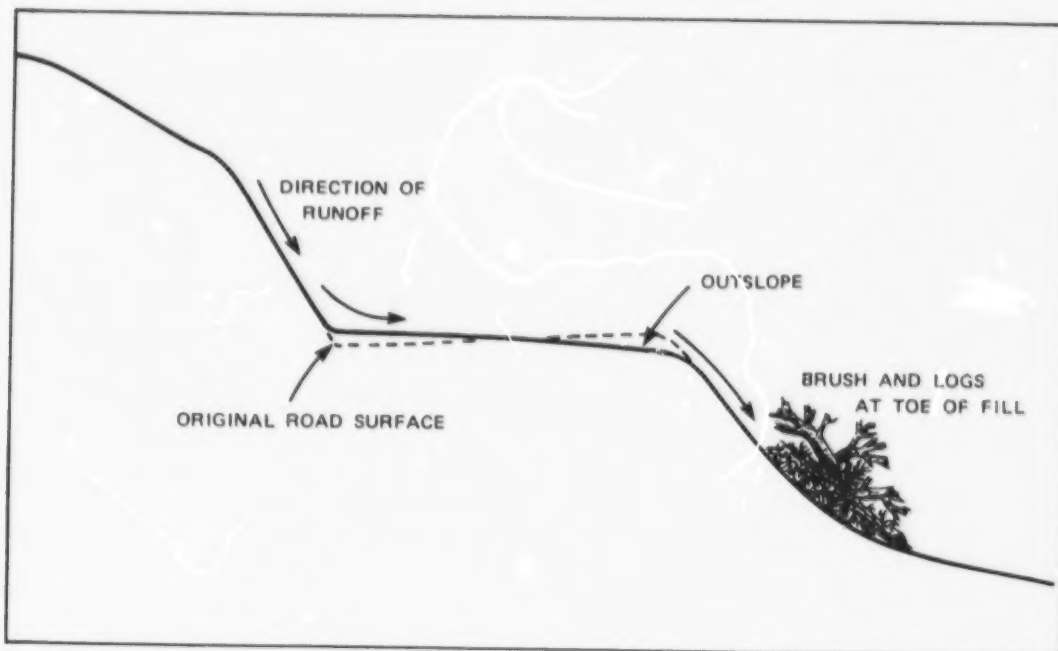


FIGURE 3
CROSS-SECTION OF AN OUTSLOPED ROAD

Stream crossings can affect fish by blocking fish migration routes, destroying stream habitat and silting downstream channels.

Different types of crossings have different impacts on fish populations and the correct choice of structure can therefore go a long way toward protection of the fishery resource. Any work that results in the harmful alteration, disruption or destruction of fish habitat is an offence under the federal *Fisheries Act*.

General

No matter what type of crossing is to be built, activity in and around watercourses must be kept to an absolute minimum.

Any construction in and around a stream channel will require careful supervision to ensure that debris and soil are not inadvertently pushed into the water. It has been shown that the cost of extra supervision during construction in sensitive areas is strongly offset by the increased efficiency of the work and the prevention of environmental damage.

Upon completion of a crossing structure, all debris must be removed from below the high water mark since it may otherwise enter the stream during heavy runoff. Clogging with debris is one of the major causes of crossing failure. Any bridge abutments or fill

slopes that are constructed below high water must be stabilized with rip-rap to prevent erosion.

Water from small or intermittent streams must not be diverted along roadside ditches.

All streams, whether flowing continually or intermittently, should be crossed using one of the following procedures:

Bridges

Bridge crossings must be used on any streams that support fish populations or on any streams with a channel width greater than 3 metres. Properly constructed bridges do not alter stream flow characteristics or stream habitat.

A plan for a simple log bridge suitable for crossing a small stream is given in Figure 4. This bridge can be built of local materials, perhaps utilizing trees felled during road clearing.

Figure 5 presents a bridge plan based on Ministry of Forests standards for use on larger channels. Large bridges should be engineered and built by personnel familiar with bridge construction.

Guidelines for bridge construction:

- o Rough-notch all crib joints to improve seating and reduce the spacing between logs. Some blocking may be necessary to prevent backfill from spilling out during floods, as loss of crib filling will lead to bridge failure. Use coarse gravel or cobbles to fill cribs as this material is less likely to erode between the logs.
- o Construct bridge spans that are long enough to ensure solid abutment footing. Many failures have occurred because of erosion of abutments that were extended too far into the stream channel.
- o Construct bridges so that water will be able to flow around the structure via old backwater channels in case of a large flood. Do not raise the road grade in these areas.

Culverts

Even when installed in the best possible manner culverts disrupt stream habitat and increase water velocity, causing restriction of fish passage. Culvert crossings are therefore recommended only for small streams that do not support fish populations.

On streams not specifically designated as fish habitat but where there is a possibility that fish exist, culverts may be used provided that their installation causes minimum restriction to fish migration.

A properly installed culvert will minimize water velocity while maintaining as many natural stream characteristics as possible.

Hanging outfalls must be avoided. These may be caused by improper installation of the culvert or by erosion at the outlet. The latter may be minimized by protecting the channel below the culvert with rip-rap.

A SIMPLE-STRONG BRIDGE DECK

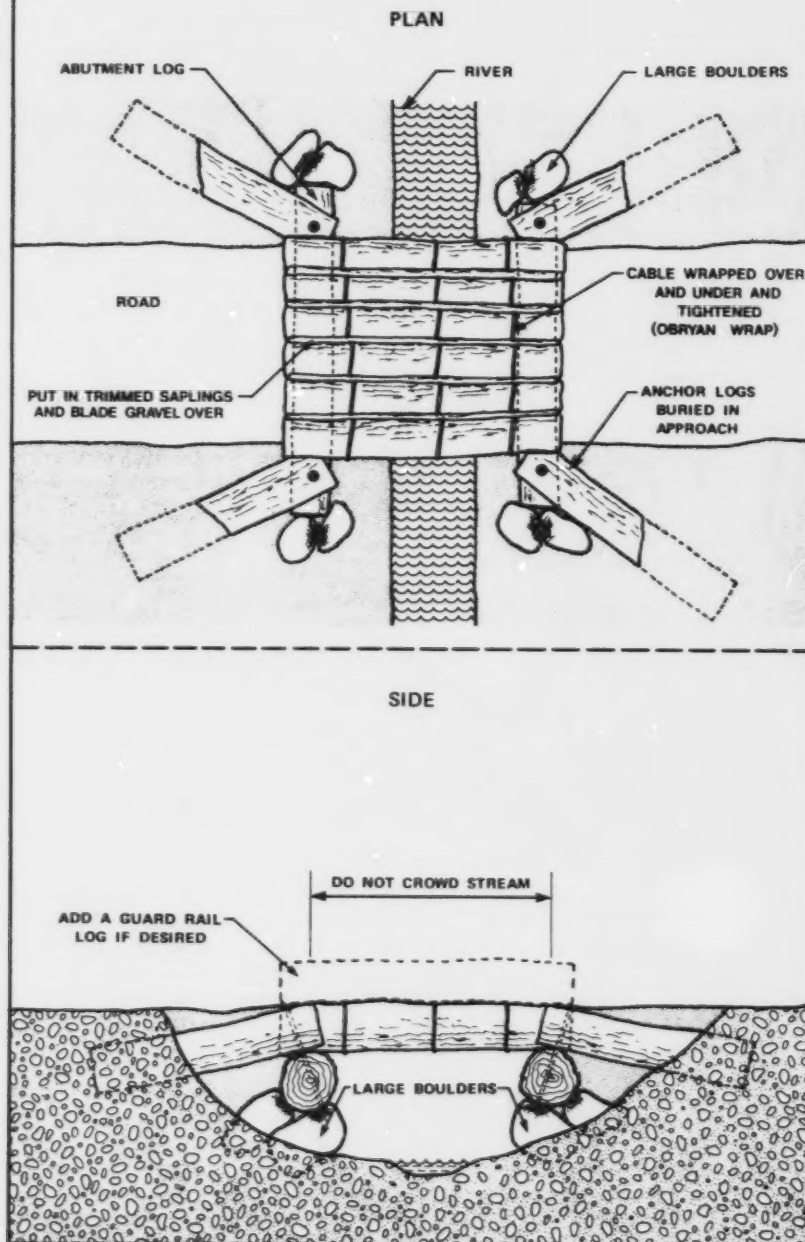
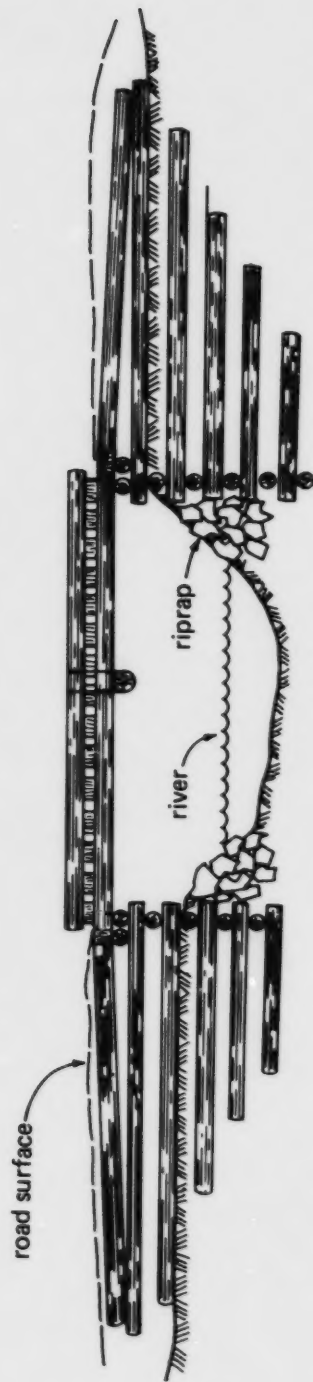


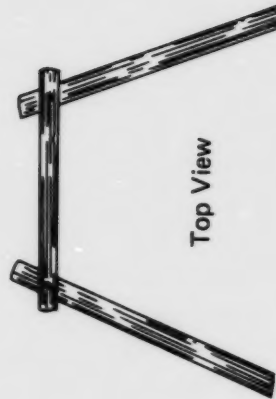
FIGURE 4

A SIMPLE TEMPORARY BRIDGE CONSTRUCTED FROM EASILY AVAILABLE MATERIALS

General Configuration



Abutment



Top View

Deck Detail



curbs tied in; midspan
needle beam

curbs not tied in; no needle
beam

FIGURE 5

SIMPLE BRIDGE DESIGN FOR USE ON LARGER CHANNELS

Water velocity can be reduced by installing the culvert as level as possible while still maintaining an acceptable flow. Installations should be deep enough in the existing stream bed to allow a sufficient depth of water in the culvert to permit fish passage.

Under cold conditions culverts may become plugged with ice. Iced up culverts usually thaw much more slowly than the adjacent stream and may therefore cause blockages. This can lead to flooding, road washouts and disruption of fish passage. Large culverts and a maintenance system for ice removal may be required under cold conditions.

Fords

The use of fords as stream crossings requires the permission of the Ministry of Environment, Fish and Wildlife Branch.

Fords may be approved only on channels with coarse, cobbly beds and they must be constructed to minimize sediment release during vehicle crossings. Construction of fords may require the removal of large boulders and debris, but in no case may the stream bed be disturbed or modified in any way. If a ford requires constant maintenance to remain passable, then an alternate type of crossing must be used.

Fords with a constructed concrete bed have been used on small creeks with high debris loads and intermittent high discharge.

Debris Bridges

Debris bridges, consisting of slash and fill pushed into a stream channel for temporary or permanent access, are not permitted.

3.3 DRILLING

The impact of drilling alone is quite small and can be minimized by proper planning and good work practices.

Although the location of drill holes is dictated by geological, geophysical or geochemical anomalies, slight relocations are often possible to avoid problem areas. Do not locate drill sites on unstable slopes, steep terrain or wet areas as this will significantly increase construction and reclamation difficulties. Drill holes shall not be located within 50 metres of streams or lakes except with the approval of an Inspector. Use the smallest possible drill pad area consistent with safe working practices. Trees should be felled and bucked according to slashing guidelines.

If stripping or levelling of a drill site area is required for safe location of a drill pad, topsoil and overburden must be removed and stockpiled for use in reclamation when the drill site is abandoned.

At the completion of drilling the site should be resloped and revegetated according to the *Reclamation Guidelines* (Chapter IV).

An adequate closed circuit facility must be provided for drilling mud and flocculating agents. Drill sludge shall not be allowed to enter streams or lakes, or to run uncontrolled. A small well-constructed settling pond or sump a short distance downslope from the drill is usually adequate.

All surface drill holes that encounter uranium or thorium mineralization in excess of 0.05% by weight at a designated site must be sealed by completely filling with concrete in accordance with Schedule D of the *Exploration Regulation - Uranium and Thorium*.

If, during drilling operations at a designated site any groundwater issues from a borehole, the flow of water must be stopped or contained in a containment structure until the water has been sampled, analyzed and found to be acceptable in accordance with Schedules D and E of the *Exploration Regulation - Uranium and Thorium*.

If, during drilling operations at other than a designated site any groundwater is released to the surface, the drill hole location must be immediately reported to an Inspector. If, in the opinion of the Inspector, the flowing hole is creating an environmental or health hazard the hole shall be cemented or otherwise plugged to prevent the flow of water.

Helicopter accessed drilling may be prescribed in environmentally sensitive areas.

3.4 TRENCHING

Trenching has, in the past, caused severe disturbance in many areas.

For all trenching programs, careful planning is necessary to identify trench sites that will give the greatest amount of information with the smallest amount of disturbance.

In all cases, trenches should be located at right angles to the strike on slopes greater than 26 degrees (2 horizontal : 1 vertical).

No water may be allowed to escape from a trench or other excavation at a designated site until samples of the water have been taken, analyzed and found to be acceptable in accordance with Schedules D and E of the *Exploration Regulation - Uranium and Thorium*.

Overburden to root depth must be segregated for use in resloping. Under no circumstances should material be cast downhill. After geological work has been completed and before the end of the season, the trench must be reclaimed and revegetated according to the *Reclamation Guidelines* (Chapter IV).

The three most common methods of trenching are discussed below.

HAND TRENCHING

The major advantage of hand trenching is that road access to the trench site is not necessary. This greatly decreases the disturbed area and allows trenching on sites that are not otherwise accessible. Because the trench itself is small and disturbance is limited, requirements for backfilling and reclamation are greatly reduced.

BACKHOE TRENCHING

The backhoe was designed as a trenching tool.

Backhoe trenches are usually quite narrow and thus cause little disturbance. Topsoil and overburden are easily removed and stockpiled adjacent to the trench for use in resloping. The backhoe, a small dozer or a skidder can be used for backfilling and site preparation.

Backhoe trenches greater than 1.5 metres deep must have their walls sloped back or be provided with adequate structural support to prevent collapse ^{if} it is necessary for a person to enter for mapping or sampling.

BULLDOZER TRENCHING

Bulldozer trenching is not permitted except with the approval of an Inspector.

3.5 UNDERGROUND DEVELOPMENT

Surface disturbances associated with underground development can present problems in erosion control, dump stability, acid drainage and reclamation.

The following general guidelines shall be followed:

- o Strip topsoil and overburden from the portal site, stockpile separately and use to cover disturbances upon completion.
- o Leave a minimum 50 metres between any surface disturbance and a lake or stream.
- o Provide for adequate diversion of surface drainage around the portal site and onto stable areas adjacent to disturbances.
- o Ensure that waste rock is not placed in any watercourse.
- o Portals must be closed to the satisfaction of the Inspector of Mines and Resident Engineer upon completion of work or abandonment of the work site.
- o No water from an underground exploration area at a designated site may be allowed to escape into surface waters until samples of the water have been analyzed and found to be acceptable in accordance with Schedules D and E of the *Exploration Regulation - Uranium and Thorium*.

ACID MINE DRAINAGE

Wherever there is potential for acid generation due to development work in pyritic ores or host rocks, the following additional requirements must be met:

- o Samples of ore and waste rock must be tested for acid production and acid consumption potential, and the results of the testwork submitted to the Inspector of Mines and Resident Engineer as well as the Ministry of Environment.
- o A plan for the disposal of acid generating materials and prevention of acid mine drainage must be submitted to the Inspector of Mines and Resident Engineer for review by the regional Mine Development Advisory Committee.

IV. RECLAMATION GUIDELINES

The following guidelines are minimum requirements and, depending on the nature of the exploration activity and the environmental sensitivity of the area, increased standards may be required as a condition of the reclamation permit.

4.1 CAMP SITES

Camp sites which are to be abandoned shall be dismantled at the end of operations. All refuse shall be burned, buried or removed. All pits shall be backfilled. The site shall be ripped, if necessary to break surface compaction, and revegetated.

Camp sites which are to be maintained for future use shall be left in a clean and tidy condition at the end of operations. All refuse shall be burned, buried or removed and all pits backfilled.

4.2 TRENCHES, DRILL SITES AND MAJOR EXCAVATIONS

All trenches, drill sites and major excavations shall be backfilled and recontoured as nearly as possible to the previously existing slope. Stockpiled topsoil and overburden shall be spread over the site and the entire site shall be revegetated. Surface drainage shall be diverted around disturbed areas. Where this is not possible, erodible material must be protected by rip-rapping or some other acceptable means.

In addition, where exploration at a designated site results in any exposed surfaces or excavated materials including drill core, cuttings or rock samples that emit radiation above the baseline level, the exposed surfaces or materials shall, if required by the Inspector of Mines and Resident Engineer, be covered with a suitable material in accordance with Schedule D of the *Exploration Regulation - Uranium and Thorium*.

4.3 UNDERGROUND PORTALS AND WASTE DUMPS

Portal areas and waste rock dumps shall be recontoured, dressed with available stockpiled topsoil and revegetated. Any drainage from the portal shall be directed away from unstable slopes and onto the forest floor. Portals shall be backfilled or otherwise sealed to the satisfaction of the Inspector of Mines and Resident Engineer.

If acid generation tests (see Section 3.5) indicate a potential for acid mine drainage, special waste rock disposal and reclamation treatments may be prescribed.

4.4 ROADS

It is important to identify those roads that can be abandoned and those roads that are necessary for future exploration. Roads that will not be used the following field season should be treated as abandoned. Some portions of the road system may be required by the Ministry of Forests for permanent fire access, therefore it is in the operator's interest to contact the Ministry of Forests in this regard.

PERMANENT ROADS

Roads that are to be retained for permanent access shall be maintained annually. Roadsides and embankment slopes shall be revegetated.

ABANDONED ROADS

All abandoned roads must have a system of permanent erosion control, with erosion bars placed at frequent intervals to ensure stability (see Figure 2). All culverts and bridges shall be removed and stream banks shall be restored as nearly as possible to their original condition.

The requirement to recontour roads will vary according to their location and environmental sensitivity as summarized below:

- o Roads on environmentally sensitive areas will require complete recontouring.
- o Roads in alpine and high subalpine areas will require the pulling back of berms containing topsoil material.
- o Other roads will only require recontouring where necessary for erosion control, although drier sites would also benefit from a dressing of topsoil.

All abandoned roads should be ditched at their junction with permanent roads.

All abandoned roads shall be ripped, if necessary to break surface compaction, and revegetated.

4.5 REVEGETATION METHODS

This section outlines revegetation treatments for the **normal** situation. Recommended seed mixtures are based on the best available knowledge at this time. There is no guarantee that these treatments will be 100 percent effective.

All disturbed areas must be stabilized and revegetated before the reclamation security can be returned. Where necessary the operator may be required to reseed poorly vegetated sites. Revegetation prescriptions are given for all areas of British Columbia in Appendix F. To find the prescription for your area, first find the region in which you are working on Figure 6 and then refer to Appendix F. In all instances, revegetation treatments require applications of both seed and fertilizer.

The introduction of non-native plant species to Recreation Areas is of concern to the Ministry of Parks. Specific revegetation proposals for Recreation Areas may therefore be subject to restrictions on the use of certain species.

METHODS OF SEED AND FERTILIZER APPLICATION

Broadcasting is the usual method for applying seed and fertilizer. Seed may be broadcast by hand, by hand-held cyclone seeders, by spreaders mounted on all-terrain vehicles or by spreaders mounted on helicopters or aircraft.



FIGURE 6

REGIONAL MAP TO BE USED IN CONJUNCTION WITH APPENDICES F AND G TO DETERMINE THE PRESCRIBED RECLAMATION TREATMENTS.

Revegetation success is increased if, following broadcasting, the seed is buried by a thin layer of soil. This may be accomplished by running a tracked vehicle over the seeded area or by harrowing the area. A design of a simple harrow is presented in Appendix E.

Hydroseeding is a technique whereby a slurry composed of seed, fertilizer, mulch (or other soil stabilizer) and water is pumped through a nozzle and sprayed over the ground.

Agricultural seed drills can also be used for seed and fertilizer applications. They are limited to well prepared, level areas.

RECOMMENDED SEED MIXTURES

Recommended seed mixtures are presented in Appendices F and G. These mixtures often contain species that cannot be obtained locally and must therefore be ordered from major seed suppliers in Vancouver. Check availability of seed mixes locally before

commencing surface work. Table 3 gives some approximations regarding seeding and fertilizing to assist in the ordering of supplies.

TABLE 3

SOME APPROXIMATIONS REGARDING SEEDING AND FERTILIZING

- 1 hectare is equal to—
 - an area 100 m by 100 m
 - 10,000 square metres
 - 2.47 acres
- 1 hectare is approximately equal to —
 - 1 km of road, 4-m road surface built across a slope.
 - 2 km of road, 4-m road surface built on level ground
- 1 kg is equal to 2.2 lbs.
- 1 lb. is equal to 0.45 kg
- 1 lb./acre is almost equal to 1 kg/ha

The time of seeding is important in some areas of the province. Poor growth results if a frost or drought occurs immediately following germination. All seeding should take place, therefore, in the fall or early spring.

RECOMMENDED FERTILIZER APPLICATIONS

Although applications of fertilizer may not always be necessary they are always recommended. Fertilizer applications are relatively inexpensive compared to the costs involved in reseeding an area, and they ensure rapid germination and increase the chances of a successful catch.

The standard recommended fertilizer application is 300 kilograms per hectare of 13-16-10. A more concentrated fertilizer such as 19-19-19 may be used at 200 kilograms per hectare. Apply fertilizer by broadcasting on the soil surface at the time of seeding. Heavier applications are recommended where rapid growth is desired or on high elevation zones (Appendix F).

4.6 REVEGETATING WITH SHRUBS

Revegetation with native shrubs can be a valuable reclamation tool, particularly in highly sensitive areas such as recreation areas, alpine tundra and grasslands. Several characteristics of shrubs make them useful for reclamation work, especially when used with a grass/legume seed mix:

o Erosion Control

Shrubs have deep woody roots which give mechanical support to slopes. When planted with grass they can help to avoid sloughing of the shallow sod layer. The woody top growth of shrubs can also help to stabilize reclaimed areas by reducing the surface wind velocity and its associated erosion.

o Wildlife Habitat

Shrubs provide a good source of food and protective cover for wildlife. Ungulates make use of many species of shrubs as browse, especially during winter when other food sources are buried beneath snow.

o Aesthetics

Shrubs are very useful for screening areas of activity from public view and for softening the harsh lines of disturbed sites.

Shrubs can be grown either from seed or from cuttings. Although the growth of root stock from seed is beyond the scope of most exploration projects, the collection of cuttings from the area surrounding an exploration site is certainly within the realm of any reclamation program. The following section describes principles and techniques used in the growth of shrubs from cuttings as applied to small reclamation projects.

SELECTION

The following factors should be considered in the selection of shrubs for use in reclamation:

- o** Shrubs used in revegetation work should be "pioneer" species, which are specifically adapted to invading an area after disturbance. They are tolerant of low moisture and nutrient conditions, and can withstand the temperature extremes typically experienced on disturbed sites. The best way to identify pioneer species is to look at areas of old disturbance near the site of the exploration project. The plants growing on these sites will have the greatest chance of success as reclamation species.
- o** Shrubs should be planted in areas with climatic conditions similar to the areas where they were originally grown. As a rule of thumb, seedlings should be planted within 166 metres (500 feet) elevation of where they were originally grown.
- o** The influence of aspect (direction of slope) should also be considered before planting. Shrubs grown on northern aspects are, in most cases, adapted to moist cool conditions and would grow poorly on dry, south-facing slopes. Similarly, shrubs grown on southern aspects would have poor success on north-facing slopes. In general, however, if shrubs are taken from areas with natural vegetation similar to that adjacent to the reclamation site, this type of problem can be avoided.

PROPAGATION

There are a number of different procedures for taking cuttings from the stems and roots of shrubs. The techniques described below should provide a high probability of success, although the best methods for a particular area or species must be determined through experimentation.

Hardwood Stem Cuttings

Hardwood cuttings may be taken during the autumn or early spring from dormant shoots of the past year's growth of deciduous species. The cuttings should be 15 to 20 centimetres long with the lowest cut 2 centimetres below a bud and the upper cut 2 centimetres above a bud. They should be planted vertically in the soil with the upper bud slightly above the soil surface.

Softwood Stem Cuttings

Softwood cuttings should be taken from leafy slips of the present year's growth of deciduous species. They should be 10 to 15 centimetres long with all but the top few leaves stripped off. The cuttings should be planted with the lowest leaf about 3 centimetres above the soil surface. The leaves stimulate rooting but can lead to the drying out of the cutting. In nurseries, these types of cuttings would normally be shaded in a coldframe or polyethylene tent. Since this will not be practical on an exploration program this method should only be used on moist or shaded sites.

Evergreen Stem Cuttings

Evergreen cuttings (from broadleaf evergreen and coniferous species) should be treated in the same way as softwood cuttings but must be prepared and planted in the early fall, after the first frosts. Cuttings may be taken from coniferous species such as juniper, or from broadleaf evergreens such as kinnikinnik. Pine, fir, balsam and spruce do not root well.

Root Cuttings

Root cuttings may often be taken from shrubs which have been uprooted by construction. They should be taken from young roots of about pencil thickness and cut into 5 to 8 centimetre lengths. Cuttings should be planted about 5 to 8 centimetres deep either horizontally or vertically, with the end cut from nearest the stem placed uppermost. This end will sprout and grow new stems.

The successful rooting of stem cuttings can be aided by wounding the base of the stem. This can be done by crushing or cutting with a knife so that the bark is broken in several places. The wounded area can then be treated with a rooting hormone to stimulate root initiation. Powdered hormone preparations are commercially available under names such as "Rootone" and "Seradix".

V. APPENDICES

- A Mines Act, Sections 6-11
- B Exploration Regulation - Uranium and Thorium
- C Notice of Work and Reclamation Program on a Mineral Property
- D Application for Approval of Underground Work
- E Design of a Simple Pipe-stem Harrow
- F Recommended Reclamation Treatments
- G Suggested Seed Mixtures for Use on Areas Disturbed by Exploration Activities in British Columbia
- H Addresses of Regulatory Agencies

APPENDIX A

1980

MINES
(Replacing RS1979, c. 52 and c. 265)

SBC CHAP. 28
INDEX CHAP. 263.5

Work system approvals

6. (1) The owner, agent or manager shall give notice to the inspector of intention to commence work on, or to stop work in or about a mine, and, except in an emergency, the notice shall be not less than 7 days.

(2) No work, other than surface exploratory work in mines that are not coal mines, shall be commenced without the written approval of the chief inspector.

(3) Before opening or beginning to open or develop a mine, the owner, agent or manager shall file with the chief inspector a report and plan of the system suitable to the chief inspector under which it is proposed to work the mine.

(4) The owner, agent or manager shall not depart from the plan of the system to any substantial degree without the written approval of the chief inspector.

(5) The plan of the system shall

- (a) be prepared taking into consideration the safety of the public and persons involved in the work,
- (b) be designed so as to make it as practicable as possible in the future to mine zones affected by the plan, and
- (c) in relation to a coal mine, provide for maximum possible recovery of the resources having regard to sound engineering practice.

Reclamation of surface

7. (1) The owner, agent or manager shall file with the minister a program for the protection and reclamation of the surface of the land and watercourses affected by the mine in a form and containing the information the minister may require before commencing preparatory work for production from a mine, and the program must include the particulars and maps that may be prescribed.

(2) Notice of the filing of the program under subsection (1) must be published, by the person filing it, in the Gazette and in those newspapers specified by the minister.

(3) A person affected by or interested in a proposed program submitted under this section may, within 30 days after the last date on which a notice is published under this section, make written representations to the minister.

Reclamation Advisory Committee

8. (1) A Reclamation Advisory Committee is established consisting of the chief inspector as chairman and other persons appointed by the minister.

(2) The minister shall submit the program and representations received by him under section 7 (1) and (3) to the committee which shall study them and make recommendations to the minister.

(3) After considering the recommendations of the committee and any representations made to him under section 7, the minister shall, within 60 days after the last date on which the notice referred to in that section is published,

- (a) approve the program,
- (b) reject the program, or
- (c) after revising or amending the program, approve it in its revised or amended form, and, where he approves a program, he shall issue a permit authorizing the work subject to compliance with the program.

(4) A permit issued under this section may contain conditions, including conditions pertaining to the future implementation of the program.

APPENDIX A (continued)

SBC CHAP. 28
INDEX CHAP. 263.5

MINES
(Replacing RS1979, c. 52 and c. 265)

29 ELIZ. 2

Security

9. (1) It is a condition of a permit issued under section 8, that the owner, agent or manager of a mine shall deposit as security with the Minister of Finance an amount the minister determines, but not exceeding \$2 500/ha of land used or to be used for the mine and the waste disposal of the mine as set out in the approved program.

(2) The security shall be held by the Minister of Finance as security for the proper performance by the owner, agent or manager of the approved program and all the conditions of the permit in a manner satisfactory to the minister, and the security may be used, on requisition of the minister, for the purposes of subsection (6).

(3) During the entire period of production from a mine, the owner, agent or manager shall

- (a) continually and progressively reclaim the surface of the land affected by the mining operation in accordance with the approved program, and
- (b) if required by the minister, deposit as security in a form satisfactory to the minister, in each year, an amount that, together with the deposit under subsection (1) and calculated over the estimated life of the mine, will provide the money necessary to perform and carry out properly
 - (i) all the requirements of the approved program at the proper time, and
 - (ii) all the orders and directions of the chief inspector or an inspector respecting the execution of the approved program.

(4) If a dispute arises respecting an order or direction of the chief inspector or an inspector under subsection (3), the owner, agent or manager may appeal in writing to the minister and the minister shall, after affording the parties the opportunity of a hearing, decide the appeal.

(5) The owner, agent or manager, or an inspector, may apply to the minister for revision of the conditions of the permit issued under section 8, and, following a recommendation of the Reclamation Advisory Committee, the minister may revise the conditions.

(6) Where the owner, agent or manager fails to perform and complete the program for reclamation and the conditions of the permit in a manner satisfactory to the minister, the minister may apply all or a part of the security toward payment of the cost of the work required to be performed and completed.

(7) On the completion, discontinuance or abandonment of a mining operation, and on the minister being satisfied that this section has been complied with and that the approved program has been properly completed, the person who deposited the security is entitled to a refund of it, less any amount paid out under subsection (6).

Exercise of minister's powers by chief inspector

10. (1) This section does not apply to a coal mine.

(2) Where a substance in a mine is not a mineral as defined in the *Mineral Act*, the chief inspector has the powers of the minister under sections 8 and 9 and may, without reference to the Reclamation Advisory Committee,

- (a) approve programs for reclamation and conservation of land comprising a mine and issue permits required under section 8, subject to conditions he may impose, or
- (b) if he is satisfied that the protection and reclamation of the land is adequately secured and controlled under an enactment, by order, exempt that mine from this section.

(3) Sections 8 and 9 do not apply in respect of all placer mining operations, other than hydraulic monitoring, and in respect of all mines in the exploration stage, but where the chief inspector considers that the employment of mechanical equipment is likely to cause significant disturbance to the surface of the land in clearing, stripping, trenching or other operations, he may

APPENDIX A (continued)

1980

MINES
(Replacing RS1979, c. 52 and c. 265)

SBC CHAP. 28
INDEX CHAP. 263.5

- (a) require the owner, agent or manager to file with him the program referred to in section 7,
- (b) approve programs for reclamation and conservation of the land surface, and
- (c) issue permits under section 8 subject to conditions he may impose.

Cancellation of permit

11. Where there is a failure to comply with the terms of a permit issued under section 8 by the minister, or section 10 by the chief inspector, and the failure continues after notice to remedy the failure, the minister or the chief inspector, as the case may be, may cancel the permit and order the owner, agent or manager of the mine to stop the mining operation and on receipt of the order the owner, agent and manager shall stop operations and close down the mine.

APPENDIX B

SCHEDULE

EXPLORATION REGULATION - URANIUM AND THORIUM

Interpretation

1. In this regulation

"Act" means the *Mines Act*;

"chief inspector" means the Chief Inspector of Mines under the *Mines Act*;

"designated area" means an area of the Province that

(a) is subject to a mineral claim under the *Mineral Act*, or

(b) is subject to a lease under the *Mining (Placer) Act*

referred to in Schedule A;

"designated site" means a site in the Province referred to in a notice sent to the chief inspector under section 2;

"exploration" means the search for coal, minerals, rock, limestone, earth, clay, sand or gravel by drilling, trenching, excavation, blasting or other disturbance of the ground by mechanical means, including underground work;

"inspector" means an inspector designated under section 2(1) of the Act.

Designated site

2.(1) Where a person intends

(a) to commence exploration or cause exploration to be commenced for uranium, thorium or both, or

(b) to commence exploration or cause exploration to be commenced in a designated area

he shall notify the chief inspector of his intention by filing the form set out in Schedule B at least 30 days before commencing exploration.

(2) A person who notifies the chief inspector under subsection (1) shall, forthwith after filing that information with the chief inspector, cause a notice of the location of the intended exploration to be published in the Gazette and in a newspaper that circulates in the area close to the designated site.

Baseline survey

3. In addition to all the requirements of the Act and the Mines Regulation, B.C. Reg. 227/83, and the Coal Mines Regulation, B.C. Reg. 226/83, no person shall commence exploration or cause exploration to be commenced at a designated site until

(a) a baseline survey of the designated site has been conducted in accordance with the requirements of Schedule C to this regulation,

(b) a copy of the results of that baseline survey has been filed with the chief inspector, and

(c) the chief inspector has given his approval for the intended exploration at that designated site.

APPENDIX B (continued)

Testing for uranium and thorium

4. Every owner, agent and manager of a mine at a designated site shall, during exploration at the designated site,

- (a) ensure that all drill cores taken during exploration and other excavated or disturbed materials resulting from exploration at that site are tested as soon as practicable,
 - (i) in the case of a drill core, after the drill core is removed from the ground, and
 - (ii) in the case of materials excavated or disturbed, after the materials are excavated or disturbed, as the case may be,for gamma radiation to detect if uranium or thorium mineralization is present,
- (b) where under paragraph (a), gamma radiation is detected as being above background level for a designated site, determine as soon as practicable after that detection, the grade of that uranium or thorium or both, as the case may be, and
- (c) keep a written record at that designated site of the grade of the uranium or thorium, determined under paragraph (b).

Uranium of 0.05% grade or more

5. Where, in the course of exploration at a designated site, uranium or thorium mineralization is encountered in a grade of 0.05% by weight or greater, the owner, agent and manager of the mine at that designated site shall

- (a) ensure that the chief inspector is informed, within 72 hours after the determination of the grade of uranium or thorium so analyzed, of the location and grade of that uranium and thorium or both, as the case may be, and
- (b) only carry out further exploration at the designated site and activities related to this exploration, including terminating this exploration at the designated site, in accordance with Schedule D.

Exploration at a site other than a designated site

6. Where in the course of exploration at a site, other than a designated site, uranium or thorium mineralization is encountered in a grade of 0.05% by weight or greater, the owner, agent and manager of the mine at that site shall ensure that

- (a) the chief inspector is informed within 72 hours after the determination of the grade of uranium or thorium so analyzed, of the location and grade of that uranium or thorium or both, as the case may be,
- (b) the form set out in Schedule B is filed with the chief inspector, within 72 hours after the determination of the grade of uranium or thorium so analyzed,
- (c) a notice of the location of the exploration is published in the Gazette and a newspaper that circulates in the area close to that location, forthwith after the grade of the uranium or thorium or both is determined,
- (d) a baseline survey of the site of the exploration is conducted within 14 days after encountering the uranium or thorium, in accordance with the requirements of Schedule C, as if this site were a designated site and for the purpose of this

APPENDIX B (continued)

section all references to designated site in Schedule C shall be interpreted as reference to a site,

- (e) a copy of the results of the baseline survey referred to in paragraph (d) is filed with the chief inspector as soon as practicable, and
- (f) all further exploration at this site and activities related to this exploration, including terminating exploration at this site, are carried out in accordance with Schedule D, as if this site were a designated site and for the purpose of this section all references to a designated site shall be interpreted as references to a site.

Offence - penalty

7. A person who contravenes this regulation commits an offence and is liable to a fine of not more than \$5000 or to imprisonment for not more than one year or both.

APPENDIX C



Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

MINERAL RESOURCES DIVISION
ENGINEERING AND INSPECTION BRANCH

NOTICE OF WORK AND RECLAMATION PROGRAM
ON A MINERAL PROPERTY

This form is to be completed and signed by all companies or individuals carrying out exploration work. Keep one copy and forward one copy to the Inspector of Mines and Resident Engineer.

REQUIREMENT TO GIVE NOTICE

This form provides notice pursuant to section 6(1) of the *Mines Act* and must be submitted not less than seven days before commencement of work, and not less than seven days prior to cessation of work. Providing this notice does not imply that the applicant can start work after seven days. **THE APPLICANT MAY ONLY COMMENCE WORK WHEN ALL ADDITIONAL APPROVALS ARE RECEIVED.**

APPROVAL OF RECLAMATION PROGRAM

This form serves as an application for a reclamation permit (section 10, *Mines Act*).

A reclamation permit will be required where the employment of mechanical equipment is likely to cause significant disturbance to the surface of the land. If a reclamation permit is required, work cannot commence until the signed permit is obtained which may require up to 60 days.

APPROVAL OF UNDERGROUND WORK

Under section 6(2) of the *Mines Act*, the owner, agent, or manager of the mine must have the written approval of the Chief Inspector of Mines before working underground. To obtain this approval the following information must be submitted to the Inspector of Mines and Resident Engineer for transmittal to the Chief Inspector of Mines:

- (1) proposed work outlined on a *Notice of Work and Reclamation Program on a Mineral Property*,
- (2) a detailed map of present and proposed underground workings,
- (3) a detailed plan of surface installations in relation to mine openings, and
- (4) a detailed plan of the system or method of carrying out the proposed work.



Reclamation Permit

Title Number

MINERAL RESOURCES DIVISION
INSPECTION AND ENGINEERING BRANCH

**NOTICE OF WORK AND RECLAMATION PROGRAM
ON A MINERAL PROPERTY**

1. NAME OF PROPERTY

Number of claims Principal Claim Group

2. LOCATION: Mining Division NTS Map Sheet (e.g., 82E/9E)

Lat. Long. UTM: E. N.

Access via

3. OWNER: Name FMC No.

Address City

Province Postal Code Telephone No.

4. OPERATOR: Name FMC No.

Address City

Province Postal Code Telephone No.

5. EXPLORATION WORK Indicate PROPOSED ☐ or COMPLETED ☐.

Duration of Exploration Work: From to

Name of Field Manager No. of men employed

Geophysical Geochemical

Linecutting (distance, width, method) m²

6. SURFACE DISTURBANCE OFF MINERAL CLAIMS

Road Access Construction: Total length m Approximate width m Area m²

Campsites: No. of men Size m²

Other (specify) m²

7. SURFACE DISTURBANCE ON MINERAL CLAIMS

(a) Road Construction: Total length m Approximate width m Area m²

(b) Drilling: No. of sites Maximum dimensions: Width m Length m

Depth m Total disturbed area of drill sites m²

Water source Method of drill mud disposal

(c) Trenches: No. Maximum dimensions: Width m Length m

Depth m Total disturbed area of trenches m²

(d) Test Pits: No. Maximum dimensions: Width m Length m

Depth m Total disturbed area of test pits m²

7. SURFACE DISTURBANCE ON MINERAL CLAIMS (CONTINUED)

(e) Camp Area: No. of men Width m Length m Area m²

(f) Underground Exploration: Area of surface facilities m²

(g) Other (specify) m²

TOTAL OF SURFACE DISTURBANCE ON MINERAL CLAIMS m²

(1 ha = 10 000 m²) ha

8. EQUIPMENT TO BE USED IN EXPLORATION PROGRAM (List size, capacity, and number.)

(a) (d)

(b) (e)

(c) (f)

9. PRESENT STATE OF THE LAND ON WHICH EXPLORATION IS PROPOSED

Present land use (agriculture, forestry, ranching, recreation, etc.)

Type of vegetation

Access roads (present use and condition)

Campsites, old workings (location, condition)

10. RECLAMATION PROGRAM (Prescribed reclamation treatments are outlined in *Guidelines for Mineral Exploration*.)

Camp sites

Trenches, drill sites, and major excavations

Roads

Seeding: Mixture

Rate of application kg/ha Date

Area seeded ha Quantity of seed kg

Fertilizer: Type Rate of application kg/ha

Area fertilized ha Quantity of fertilizer kg

11. SUMMARY OF AREAS DISTURBED AND RECLAIMED

Area disturbed current year Previous years Total to date

Area reclaimed current year Previous years (final) Total to date

12. DATE FOREST SERVICE ADVISED BY OPERATOR

Name and Title of Forest Official

Address

Signature of Applicant Title

Print Name Date

PLAN

Indicate claim boundaries, permanent watercourses, access road and distance to nearest town, proposed surface disturbances including roads, test pits, trenches, portals, drill sites, and camp sites.

LOCATION MAP

Show nearest town and access road

APPENDIX D

Province of British Columbia

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES
MINERAL RESOURCES DIVISION
ENGINEERING AND INSPECTION BRANCH

APPLICATION FOR APPROVAL OF UNDERGROUND EXPLORATION WORK

Under Section 6(2) of the Mines Act, the owner, agent or manager of the mine, must have the written approval of the Chief Inspector of Mines before working underground. To obtain this approval, this form must be completed and submitted to the Inspector of Mines and Resident Engineer for transmittal to the Chief Inspector of Mines. The application must also include:

1. Proposed work outlined on a Notice of Work and Reclamation Program on a Mineral Property form.
2. A detailed map of present and proposed underground workings.
3. A detailed plan of surface installations in relation to mine openings.

NAME OF PROPERTY: _____

MINING DEVELOPMENT DETAIL:

1. Type (i.e. raise, sub-level or drift): _____
2. Proposed length: _____
3. Dip or grade: _____

VENTILATION:

Note: A minimum airflow of 15.4 cubic metres/min. per m² of face is required for mining development ventilation.

1. Heading size - height: _____ m width: _____ m
2. Type, size and location of fan: _____
3. Size of ventilation ducting: _____
4. Ventilating airflow in cubic metres/min. supplied to working face: _____
5. Special comments if any: _____

APPLICATION FOR APPROVAL OF UNDERGROUND EXPLORATION WORK

Page 2 of 4

DRILLING:

1. Type of drills: _____
2. Approximate number of holes: _____
3. Drilling pattern: _____
4. Will a bit sharpener be on the property? Yes _____ No _____
Location: _____

EXPLOSIVES AND BLASTING PROCEDURES:

1. Explosives Storage Magazine:
 - a) An explosives storage and use permit (Licensed Magazine) has been obtained _____
 - b) Application for approved explosives storage magazine will be made _____
 - c) Application for approved explosives storage magazine has been made _____
2. a) Type of explosives to be used: _____

- b) Method of detonation (electrical or fuse and cap, etc.). Please specify in detail: _____

MUCK REMOVAL:

1. Specify in detail, system to be used: _____

2. Size and type of muck removal equipment: (mucking machine, hoist and scraper scooptram, haul cars and loci, etc.) _____

APPLICATION FOR APPROVAL OF UNDERGROUND EXPLORATION WORK

Page 3 of 4

DUMPING PROCEDURES: (size of dump and location of dump)

Specify in detail system to be used: _____

DIESEL EQUIPMENT: (mobile equipment)

Size, type, power source and H.P., and Diesel Permit Number: _____

GROUND CONTROL:

1. Timbering: Size and Type (square sets, post and lagging, spacing, etc.)

2. Rockbolting: (pattern, size, type, length of bolts, screening or strapping)

WORK SUPERVISION:

1. Shift Boss name and certificate number: _____
2. Number of employees per shift: _____
3. Total number of employees: _____
4. Type of shift schedule: _____
5. Others: _____

FIRST AID AND AMBULANCE

1. Travel time to hospital from property: _____
2. Type of emergency transport vehicle (Ambulance): _____

APPLICATION FOR APPROVAL OF UNDERGROUND EXPLORATION WORK

Page 4 of 4

3. Details of first aid provisions: _____

4. List mine rescue equipment: _____

ELECTRICAL INSTALLATION

1. Notice of introduction of electricity: _____
2. Schematic diagram of installation.
3. Plan of underground mine showing location of electrical equipment and routing size: type of cables.

PRESENCE OF WATER OR MATERIAL WHICH FLOWS WHEN WET

1. Distance above/below adit of water: _____ m

2. Proposed precautions: _____

3. Describe provisions for containing mine water: _____

FIREFIGHTING ARRANGEMENTS (please detail): _____

Signature of Applicant

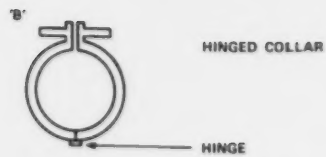
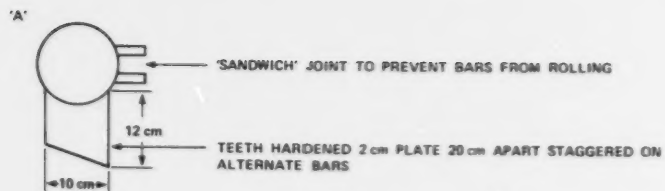
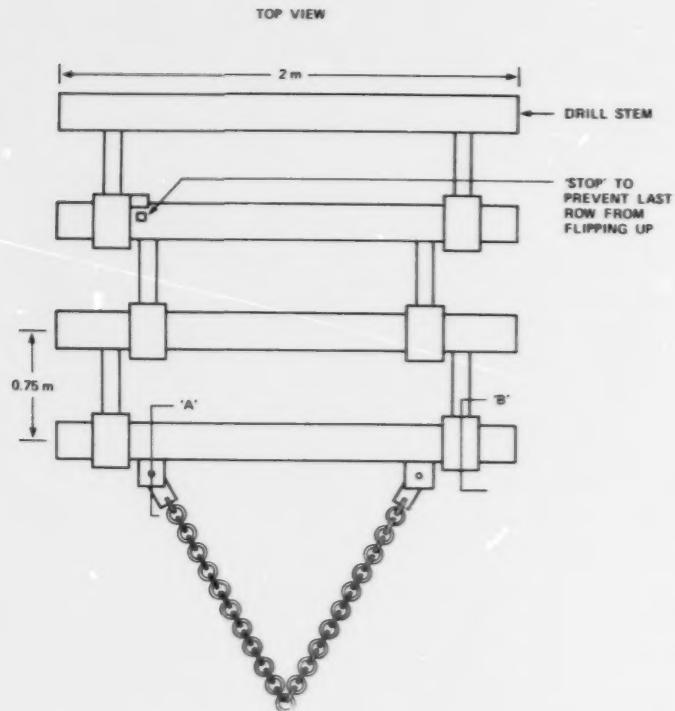
Title

Print Name

Date

APPENDIX E

DESIGN FOR SIMPLE PIPE-STEM HARROW



APPENDIX F

RECOMMENDED RECLAMATION TREATMENTS

COASTAL REGION

BIO- GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS			
			Mix- ture	SEEDING Rate kg/ha	FERTILIZER Type	Rate kg/ha
Coastal Douglas Fir	—includes the east coast of Vancouver Island south of Kelsey Bay, the Sunshine Coast, and the Fraser Valley	Southeastern Vancouver Island 0-450 m (0-1500')	I	30	avoid July and August seeding	300 (200)
	—annual precipitation high, 66-152 cm (26-60") —summers dry, winters mild —characterized by the following trees: Douglas fir, grand fir, western red cedar, arbutus, Garry oak (dry areas), lodgepole pine, Sitka spruce, bitter cherry, vine maple, bigleaf maple, and red alder	South Coast of Mainland 0-150 m (0-500')				
Coastal Western Hemlock and Coastal Cedars Pine Hemlock	—includes most of Vancouver Island and the Queen Charlotte Islands (excluding mountain tops), and the river valleys of the Pacific Coast	South—windward side 0-900 m (0-3000') South—leeward side 450-1050 m (1500-3500') North 0-300 m (0-1000')	I	30	no restrictions	300 (200)
	—annual precipitation very high, 112-665 cm (44-262"); mild winters and summers —characterized by the following trees: Douglas fir, western red cedar, yellow cedar, shore pine, western hemlock, Sitka spruce, western white pine, grand fir (in dry areas), Pacific silver fir (wet areas)					
Mountain Hemlock	—includes areas of high elevation on Pacific West Coast, Vancouver Island, and the Queen Charlotte Islands	South—windward side 900-1500 m (3000-5000') South—leeward side 1050-1800 m (3500-6000') North—300-900 m (1000-3000')	I or II	60	no restrictions	300 (200)
	—annual precipitation high, 178-432 cm (70-170"); heavy snow cover over unfrozen ground; winters not severe —characterized by the following trees: mountain hemlock, Pacific silver fir, yellow cedar, western hemlock, western red cedar					
Alpine	—includes areas of high elevation, with heavy snow cover and long snow duration —low stunted growth of alpine fir, whitebark pine, mountain hemlock	windward side above 1500 m (5000') leeward side above 1800 m (6000')	VII	60	seed in early spring or late fall only	500 (400)

APPENDIX F—Continued **RECOMMENDED RECLAMATION TREATMENTS—Continued** **SOUTHERN INTERIOR REGION**

BIO- GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS				
			SEEDING	FERTILIZER			
			Mix- ture	Rate kg/ha	Timing	Type	Rate kg/ha
Ponderosa Pine	—includes the dry river valleys of the Fraser, Thompson, Nicola, Similkameen, and Okanagan	270-750 m (900-2500')	III	30	no restrictions	13-16-10	300
Bunchgrass	—very low precipitation, 19-36 cm (7.4-14") —characterized by the following vegetation: ponderosa pine, bitter brush, sagebrush, and bunchgrass				early spring preferred	(19-19-19)	(200)
Interior Douglas Fir	—includes the majority of the City Southern Interior below 1350 m (4500') —precipitation low, 36-56 cm (14-22"), hot summers and cool winters —characterized by the following trees: Douglas fir, ponderosa pine, western white pine, white spruce, western red cedar, lodgepole pine, larch, aspen, black cottonwood, common paper birch, and Rocky Mountain maple	300-1350 m (1000-4500')	IV or V	30	early spring or late fall preferred	13-16-10 (19-19-19)	300 (200)
Interior Cedar Hemlock	—includes Interior valleys, 360-1260 m (1200-4200'), east of the Selkirk Mountains —precipitation high, 56-170 cm (22-67"), warm summers and cool winters —characterized by the following trees: western hemlock, Douglas fir, western white pine, lodgepole pine, western red cedar, Engelmann spruce, white spruce, alpine fir, grand fir, black cottonwood, aspen, common paper birch, larch	360-1260 m (1200-4200')	I	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Engelmann Spruce Subalpine Fir and Montane Spruce	—includes most areas greater than 1260 m (4200') in eastern British Columbia, south of Prince George —subalpine with moderate snow cover and severe winters; precipitation high, 41-183 cm (16-72") —characterized by the following trees: Engelmann spruce, alpine fir, lodgepole pine, white bark pine, alpine larch, limber pine, Douglas fir, western white pine	1260-2250 m (4200-7500')	VI	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Alpine	—includes areas in southeastern British Columbia at high elevations —low stunted trees: Engelmann spruce, alpine fir, white bark pine, alpine larch, alpine meadows and tundra	greater than 2250 m (7500')	VII	30	seed in early spring or late fall only	13-16-10 (19-19-19)	500 (400)

APPENDIX F—Continued
RECOMMENDED RECLAMATION TREATMENTS—Continued
CENTRAL AND NORTHERN INTERIOR REGION

BIO- GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS			
			SEEDING	FERTILIZER		
			Mix- ture	Rate kg/ha	Timing	Type Rate kg/ha
Subboreal Spruce	—includes most of the central interior with elevation 330-840 m (1100-2800') north of Williams Lake and south of Germansen Landing	Central 330-840 m (1100-2800')	V	30	no restrictions	13-16-10 (19-19-19) (200)
	—heavy snow cover; severe winters; precipitation moderate, 40-64 cm (16-25")					
	—characterized by the following trees: lodgepole pine, white spruce, alpine fir, black spruce, aspen, black cottonwood, common paper birch					
Engelmann Spruce Subalpine Fir	—includes areas of the central interior above 1050 m (3500')	Central and Northeast	VI	30	no restrictions	13-16-10 (19-19-19) (200)
	—subalpine with moderate snow cover and severe winters; precipitation high, 41-183 cm (16-72")	1050-1650 m (3500-5500')				
	—characterized by the following trees: Engelmann spruce, alpine fir, lodgepole pine, white spruce, white bark pine	Northwest 900-1500 m (3000-5000')				
Boreal White and Black Spruce	—includes all areas below 840 m (2800') in the northern interior	Northeast and Northwest	VI	30	no restrictions	13-16-10 (19-19-19) (200)
	—moderate or light snow cover over deeply frozen ground; winters severe; moderate precipitation, 30-58 cm (12-23")	163-840 m (550-2800')				
	—characterized by the following trees: white spruce, black spruce, tamarack, alpine fir, aspen, thin-leaved mountain alder, common paper birch, black cottonwood					
Spruce Willow Birch and Alpine	—includes all high elevation areas in the northern interior	Northeast	VII	60	seed in early spring or late fall	13-16-10 (19-19-19) (400)
	—moderate snow cover	greater than 1650 m (5500')				
	—characterized by stunted tree growth of alpine fir and scrub glandular birch; alpine tundra occurs at higher elevations	Northwest greater than 1500 m (3500')				

APPENDIX G

SUGGESTED SEED MIXTURES FOR USE ON AREAS DISTURBED BY EXPLORATION ACTIVITIES IN BRITISH COLUMBIA

Mixture	Biogeoclimatic Zone	Species	% by wt.
I	Coastal Douglas Fir Coastal Western Hemlock Interior Cedar Hemlock Coastal Cedars Pine Hemlock	Timothy	10
		Perennial Rye	20
		Orchard Grass	15
		Creeping Red Fescue	20
		Canada Bluegrass	5
		White Dutch Clover	30
II	Mountain Hemlock	Orchard Grass	40
		Creeping Red Fescue	40
		Perennial Rye	10
		White Dutch Clover	10
III	Ponderosa Pine Bunch Grass	Crested Wheatgrass	70
		Alfalfa	30
IV	Interior Douglas Fir (dry)	Streambank Wheatgrass	30
		Crested Wheatgrass	40
		Alfalfa	15
		Sainfoin	15
V	Interior Douglas Fir (wet) Sub-boreal Spruce	Creeping Red Fescue	30
		Timothy	20
		Orchard Grass	20
		Alsike Clover	30
VI	Engelmann Spruce Subalpine Fir Boreal White and Black Spruce Montane Spruce	Creeping Red Fescue	40
		Timothy	40
		Alsike Clover	20
		(Red Top)	
VII	Alpine Tundra Spruce Willow Birch	Meadow Foxtail	10
		Creeping Red Fescue	40
		Timothy	25
		Tracenta Bentgrass	10
		Alsike Clover	15

APPENDIX H

ADDRESSES OF REGULATORY AGENCIES

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

Chief Inspector of Mines	Rm. 105, 525 Superior St., Victoria	356-2200
Head of Reclamation	Rm. 105, 525 Superior St., Victoria	356-2214

INSPECTOR OF MINES AND RESIDENT ENGINEERS

Fernie	Bag 1000, Cranbrook Rd.	423-6884
Kamloops	101 - 2985 Airport Dr.	828-4566
Nanaimo	1A - 3411 Shenton Rd.	755-2486
	Vancouver callers	660-9363
Nelson	310 Ward St. (mail)	354-6125
	403 Vernon St. (office)	
Prince George	1652 Quinn St.	565-6125
Smithers	Bag 5000, 3793 Alfred Ave.	847-7383

GOLD COMMISSIONER OFFICES

Alberni	4515 Elizabeth St., Port Alberni	724-9204
Atlin	Box 100, Atlin	651-7595
Cariboo	102 - 350 Barlow Ave., Quesnel	992-4223
Clinton	Box 70, Clinton	459-2268
Fort Steele	102 - 11th Ave. S., Cranbrook	426-1249
Golden	Box 39, Golden	344-7550
Greenwood	Box 850, Grand Forks	442-5444
Kamloops	7 Seymour St. W., Kamloops	828-4545
Liard	Box 340, Cassiar	778-7852
Lillooet	Court House, Bag 700, Lillooet	256-7548
Nanaimo	13 Victoria Crescent, Nanaimo	755-2220
Nelson	310 Ward St., Nelson	354-6109
New Westminster	100 - 635 Columbia St., New Westminster	660-8676
Nicola	Bag 4400, Merritt	378-9343
Omineca	Bag 5000, 3793 Alfred Ave., Smithers	847-7233
Osoyoos	Rm. 112, Court House, Penticton	492-1200
Revelstoke	Box 380, Revelstoke	837-7684
Similkameen	Box 9, Princeton	295-6957
Skeena	Court House, Prince Rupert	627-0406
Slocan	Box 580, Kaslo	353-2219
Trail Creek	Box 910, Rossland	362-7324
Vancouver	800 Hornby St., Vancouver	660-2672
Vernon	Court House, Vernon	549-5515
Victoria	525 Superior St., Victoria	356-2251

MINISTRY OF CROWN LANDS

Burnaby	210 - 4240 Manor St.	660-5500
Cranbrook	828A Baker St.	426-1414
Fort St. John	220, 9900 - 100th Ave.	787-3411
Kamloops	348 Tranquille Rd.	554-3144
Prince George	1011 Fourth Ave.	565-6245
Smithers	3726 Alfred Ave.	847-7334
Victoria	851 Yates St.	387-5011
Williams Lake	201 - 172 North 2nd Ave.	398-4250

APPENDIX H (continued)

MINISTRY OF ENVIRONMENT - FISH AND WILDLIFE BRANCH

Kamloops	1259 Dalhousie Dr.	374-9717
Nanaimo	2569 Kenworth Rd.	758-3951
Nelson	310 Ward St.	354-6344
Penticton	201 - 3547 Skaha Lake Rd.	493-8261
Prince George	1011 Fourth Ave.	565-6145
Smithers	Bag 5000, 3726 Alfred Ave.	847-7303
Surrey	10334 - 152A St.	584-8822
Williams Lake	540 Borland St.	398-4530

MINISTRY OF ENVIRONMENT - WASTE MANAGEMENT BRANCH

Kamloops	1259 Dalhousie Dr.	374-9717
Nanaimo	2569 Kenworth Rd.	758-3951
Nelson	310 Ward St.	354-6355
Penticton	201 - 3547 Skaha Lake Rd.	493-8261
Prince George	1011 Fourth Ave.	565-6155
Smithers	Bag 5000, 3726 Alfred Ave.	847-7260
Surrey	10334 - 152A St.	584-8822
Williams Lake	540 Borland St.	398-4531

MINISTRY OF ENVIRONMENT - WATER MANAGEMENT BRANCH

Kamloops	1259 Dalhousie Dr.	374-9717
Nanaimo	2569 Kenworth Rd.	758-3951
Nelson	310 Ward St.	354-6370
Penticton	201 - 3547 Skaha Lake Rd.	493-8261
Prince George	1011 Fourth Ave.	565-6160
Smithers	Bag 5000, 3726 Alfred Ave.	847-7278
Surrey	10334 - 152A St.	584-8822
Williams Lake	540 Borland St.	398-4531

MINISTRY OF FORESTS

Burnaby	595 Canada Way	660-7500
Kamloops	515 Columbia St.	828-4131
Nelson	518 Lake St.	354-6203
Prince George	1011 Fourth Ave.	565-6100
Smithers	Alfred Ave.	847-7500
Williams Lake	540 Borland St.	398-4345

MINISTRY OF PARKS

Kamloops	101 - 1050 West Columbia Ave.	828-4501
Prince George	1011 Fourth Ave.	565-6270
Vancouver	1610 Mt. Seymour Dr.	929-1291

DEPARTMENT OF FISHERIES AND OCEANS

District Offices		
Campbell River	215 - 950 Alder St.	287-2102
Kamloops	202 - 317 Seymour St.	374-4322
Nanaimo	305 - 60 Front St.	754-0204
New Westminster	301 - 80 Sixth St.	666-2618
Port Alberni	3019 Fourth Ave.	724-0195

APPENDIX H (continued)

DEPARTMENT OF FISHERIES AND OCEANS (continued)

Prince Rupert	109 - 417 Second Ave. West	624-9137
Queen Charlotte City	Box 99	559-4413
Victoria	423 - 1230 Government St.	388-3252
Whitehorse	122 Industrial Rd.	(403) 667-2235
Habitat Management Offices		
Kamloops	202 - 317 Seymour St.	374-4322
Nanaimo	305 - 60 Front St.	754-0204
New Westminster	330 - 80 Sixth St.	666-0315
Prince George	2392 Ospika Blvd.	561-5366
Whitehorse	122 Industrial Rd.	(403) 667-2235